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Evaluation of sleep disorders before and after transplantation in patients undergoing hematopoietic stem cell transplantation

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Abstract. – OBJECTIVE: Hematopoietic stem cell transplantation (HSCT) is an important curative treatment option for many hematologic diseases. Sleep disorders in patients with HSCT are a significant but often overlooked health problem. Therefore, this study aims to determine the frequency of sleep disorders in HSCT patients and to compare and evaluate the data before and after transplantation between autologous and allogeneic HSCT patient groups.

PATIENTS AND METHODS: Patients who were referred to the Bone Marrow Transplantation Centre Clinic at Medicana International Istanbul Hospital by other centres and those who were suitable for HSCT treatment according to evaluations were included in the study. The patients underwent allogeneic and autologous HSCT. The Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS) and Insomnia Severity Index (ISI) were applied to both groups before transplantation and on the 7th and 100th days after transplantation.

RESULTS: The PSQI total and sub-scale scores, ESS scores and ISI scores on the 7th and 100th days after transplantation were statistically significantly lower than the scores before transplantation.

CONCLUSIONS: Sleep disorders were significantly reduced in patients after HSCT. Moreover, the scores in the seven subscales of the PSQI statistically significantly decreased on the 7th and 100th days after transplantation, and sleep statistically improved and showed great improvement on the 100th day after transplantation. We believe that early detection and treatment of sleep disorders may be beneficial for this group of patients to improve their quality of life and response to treatment.

Key Words:
Sleep disorders, Hematopoietic stem cell transplantation, Pittsburgh sleep quality index, Epworth sleepiness scale, Insomnia severity index.

Introduction

Hematopoietic stem cell transplantation (HSCT) is an important curative treatment option for many malignant and non-malignant hematologic diseases. HSCT is commonly used in the treatment of acute lymphoid leukaemia, acute myeloid leukaemia, plasma cell diseases, multiple myeloma and autoimmune diseases. HSCT has two different types: autologous and allogeneic. Allogeneic HSCT can be curative for fatal hematologic malignancies, such as acute myeloid leukemia and aplastic anemia. The number of people who undergo autologous or allogeneic HSCT worldwide increases every passing day, and more than 50,000 HSCTs are performed every year[1-4]. In autologous HSCT, stem cells are taken from the patient, whereas in allogeneic HSCT, stem cells are taken from a related or unrelated donor[5]. To prevent acute or chronic graft versus host disease that may develop after transplantation, preparatory procedures consisting of intensive chemotherapy and/or radiotherapy are applied for 7-10 days before HSCT[2,6]. This treatment has many side effects, such as nausea, vomiting, pancytopenia, infection, and weight loss due to these treatment procedures, but the incidence of side effects decreases as the treatment procedures are improved. However, there is an increase in the emergence of psychosocial effects, such as anxiety, depression, post-traumatic stress disorder and sleep disorders[2].

Sleep disorders, which consist of complaints such as difficulty in falling or maintaining sleep, waking up earlier than planned, deterioration in sleep quality and insomnia, are significant health problems that greatly affect the quality of life and physical and mental health. In the presence of life-threatening conditions, such as malignancy,

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they can lead to more significant consequences[7,8]. Sleep disorders are quite common in patients undergoing HSCT, both before and after transplantation and during the period when patients are hospitalised for transplantation, but they are usually overlooked and not questioned much[1,9]. Previous studies have shown that sleep disorders are more common in HSCT patients, especially in older age and female gender. Moreover, sleep disorders are more common in people with malignancy who have undergone HSCT due to the fear of recurrence[8].

Sleep disorders in patients with HSCT are a significant but often overlooked health problem. Therefore, this study aims to determine the frequency of sleep disorders, insomnia, and impaired sleep quality in HSCT patients and to compare and evaluate the data before and after transplantation between autologous and allogeneic HSCT patient groups.

Patients and Methods

Patients who were referred to the Bone Marrow Transplantation Centre Clinic at Medicana International Istanbul Hospital by other centres and those who were suitable for HSCT treatment according to evaluations were included in the study.

Of the 65 patients who underwent HSCT between the specified dates, 11 patients with psychiatric comorbidities and psychiatric drug use in their history and 4 patients who had previously been diagnosed with sleep disorders and started treatment were excluded from the study. Overall, 50 patients were included in the study. Age, gender, educational status, diagnosis of primary disease, comorbidities and drugs used were noted from the files of the patients. The patients were then divided into two groups: allogeneic HSCT and autologous HSCT. The allogeneic HSCT group was given a preparatory procedure, starting approximately seven days before transplantation, and chemotherapy treatment was given three days immediately after transplantation. In the autologous HSCT group, a preparation procedure was given only three days before transplantation, usually provided with monotherapy, and the group was followed up without drug treatment after transplantation. The Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS) and Insomnia Severity Index (ISI) were applied to both groups before transplantation and on the 7th and 100th days after transplantation.

The PSQI is a self-report questionnaire consisting of 19 items that evaluate the quality and quantity of sleep. It has seven components: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction. The points given to the items are scored in the range of 0-3. The maximum score is 21. An increase in the score indicates worse sleep quality[7,10]. In this study, those with a total PSQI score of ≤ 5 were considered normal, and those with a total PSQI score of > 5 were considered to have a sleep disorder[11].

The ESS is a short questionnaire consisting of eight items, with each item scored on a scale of 0-4 points. The maximum score is 24[12]. In this study, the total ESS score was classified as follows: 0-5 = normal, 6-10 = mild sleepiness, 11-12 = moderate sleepiness, 13-15 = severe sleepiness and 16-24 = excessive sleepiness.

The ISI is a seven-item questionnaire, with each item scored on a scale of 0-4. High scores indicate increased insomnia and its associated daytime symptoms. The maximum score is 28[13]. In this study, the total ISI score was categorised as follows: 0-7 = insignificant insomnia, 8-14 = subthreshold insomnia, 15-21 = moderate insomnia and 22-28 = severe insomnia.

Statistical Analysis

The mean, standard deviation, median, minimum, maximum, frequency, and ratio values were used in the descriptive statistics of the data. The distribution of the variables was measured using the Kolmogorov-Smirnov test. The Mann-Whitney U test was used in the analysis of independent quantitative data. The Wilcoxon test was used in the analysis of the dependent quantitative data. In the analysis of qualitative independent data, the Chi-square test and Fisher test were used when the Chi-square test did not meet the test conditions. The McNemar test was used in the analysis of the dependent qualitative data. The SPSS 28.0 programme (IBM Corp., Armonk, NY, USA) was used in the analyses. *p*-values less than 0.05 were considered significant.

Results

The ages of the patients included in the study were between 17 and 74 years, and the mean age was 43.2 ± 15.4 years. Of the patients, 33 (66%) were male, and 17 (34%) were female. In terms of

educational status, 1 (2%) patient was illiterate, 7 (14%) were primary school graduates, 8 (16%) were secondary school graduates, 13 (26%) were high school graduates, and 21 (42%) were university graduates. Allogeneic HSCT was performed in 31 (62%) patients, and autologous HSCT was performed in 19 (38%) patients.

According to the PSQI scale, 14 (28%) patients did not have sleep disorders, and 36 (72%) had sleep disorders. According to the ESS scores, 19 (38%) patients were found to have normal sleepiness, 13 (26%) had mild sleepiness, 5 (10%) had moderate sleepiness, 4 (8%) had severe sleepiness, and 9 (18%) had excessive sleepiness. According to the ISI, 9 (18%) patients did not have insomnia, 26 (52%) had subthreshold insomnia, 13 (26%) had moderate insomnia, and 2 (4%) had severe insomnia (Table I).

The PSQI total and sub-scale scores, ESS scores and ISI scores on the 7th and 100th days after transplantation were statistically significantly lower than the scores before transplantation (Table II).

In terms of the demographic data of the patients according to the type of transplantation, no significant difference was found in the demographic data ($p > 0.05$) in the autologous and allogeneic HSCT groups. In the allogeneic HSCT group, the total PSQI score before transplantation was significantly higher ($p < 0.05$) than in the autologous HSCT group. In both the autologous HSCT group and the allogeneic HSCT group, the total PSQI scores on the 7th and 100th days after transplantation were significantly lower than those before transplantation. In the allogeneic HSCT group, the decrease in the total PSQI score

Table I. Demographic data of the patients, types of transplants and results of the PSQI, ESS and ISI.

		Min-Max	Median	Mean ± SD/n-%
Age		17.0 - 74.0	42.5	43.2 ± 15.4
Gender	Male			33 66.0%
	Female			17 34.0%
Educational status	Illiterate			1 2.0%
	Primary school			7 14.0%
	Secondary school			8 16.0%
	High school			13 26.0%
	University			21 42.0%
Transplantation type	Autologous			19 38.0%
	Allogeneic			31 62.0%
PSQI		0.0 - 20.0	11.0	9.46 ± 5.61
Sleep disturbances	No			14 28.0%
	Yes			36 72.0%
Sleep quality		0.0 - 3.0	2.0	1.68 ± 0.94
Sleeping latency		0.0 - 3.0	2.0	1.54 ± 1.01
Sleep duration		0.0 -3.0	2.0	1.56 ± 0.95
Sleep efficiency		0.0 - 3.0	2.0	1.52 ± 1.01
Sleep disturbances		0.0 - 3.0	1.0	1.42 ± 0.93
Use of sleeping medication		0.0 - 3.0	1.0	0.92 ± 0.97
Daytime dysfunction		0.0 - 3.0	1.0	0.90 ± 0.84
Epworth sleepiness scale classification	Normal			19 38.0%
	Mild sleepiness			13 26.0%
	Moderate sleepiness			5 10.0%
	Severe sleepiness			4 8.0%
	Excessive sleepiness			9 18.0%
Insomnia severity index classification	Indifferent			9 18.0%
	Subthreshold insomnia			26 52.0%
	Moderate insomnia			13 26.0%
	Severe insomnia			2 4.0%

Table II. Comparison of the PSQI, ESS and ISI scores before transplantation and on the 7th and 100th days after transplantation.

		Before transplantation	7th day	100th day	p 7	p 100
PSQI total	Avg. ± SD Median	9.46 ± 5.61 11.0	4.74 ± 3.69 6.0	2.16 ± 2.49	< 0 .001 W 1.0	< 0.001 W
Sleep quality	Avg. ± SD Median	1.68 ± 0.94 2.0	0.90 ± 0.84 1.0	0.34 ± 0.56 0.0	< 0.001 W	< 0.001 W
Sleeping latency	Avg. ± SD Median	1.54 ± 1.01 2.0	0.74 ± 0.85 1.0	0.30 ± 0.54 0.0	< 0.001 W	< 0.001 W
Sleep duration	Avg. ± SD Median	1.56 ± 0.95 2.0	0.80 ± 0.81 1.0	0.26 ± 0.53 0.0	< 0.001 W	< 0.001 W
Sleep efficiency	Avg. ± SD Median	1.52 ± 1.01 2.0	0.78 ± 0.76 1.0	0.34 ± 0.52 0.0	< 0.001 W	< 0.001 W
Sleep disturbances	Avg. ± SD Median	1.42 ± 0.93 1.0	0.84 ± 0.77 1.0	0.40 ± 0.61 0.0	< 0.001 W	< 0.001 W
Use of sleeping medication	Avg. ± SD Median	0.92 ± 0.97 1.0	0.36 ± 0.63 0.0	0.28 ± 0.57 0.0	< 0.001 W	< .001 W
Daytime dysfunction	Avg. ± SD Median	0.90 ± 0.84 1.0	0.34 ± 0.63 0.0	0.14 ± 0.40 0.0	< 0.001 W	< 0.001 W
PSQI sleep disorder						
No Yes	n-% n-%	14 28% 36 72%	24 48% 26 52%	44 88% 6 12%	0.002 N	< 0.001 N
Epworth sleepiness scale classification						
Normal Mild Moderate Severe Excessive	n-% n-% n-% n-% n-%	19 38% 13 26% 5 10% 4 8% 9 18%	24 48% 13 26% 7 14% 0 0% 6 12%	43 86% 4 8% 3 6% 0 0% 0 0%	**< 0.001** N	**< 0.001** N
Insomnia severity index classification						
Indifferent Subthreshold insomnia Moderate insomnia Severe insomnia	n-% n-% n-% n-%	9 18% 26 52% 13 26% 2 4%	18 36% 26 52% 6 12% 0 0%	37 74% 12 24% 1 2% 0 0%	**0.004** N	**< 0.001** N

WWilxocon test/N Mc Nemar test. *p* 7 Difference with the 7th day after transplantation/*p* 100 Difference with the 100th day after transplantation

after transplantation was significantly higher ($p < 0.05$) than the decrease in the total PSQI score in the autologous HSCT group (Table III).

The PSQI sleep disorder score before and after transplantation was significantly higher ($p < 0.05$) in the allogeneic HSCT group on the 7th day than in the autologous HSCT group. The rate of PSQI sleep disorder on the 100th day after transplantation did not show a significant difference between the autologous and allogeneic HSCT groups ($p > 0.05$). In the autologous HSCT group, the rate of PSQI sleep disturbances on the 7th day after transplantation did not show a significant change ($p > 0.05$) compared to the rate before transplantation, whereas the rate of PSQI sleep disturbances on the 100th day after transplantation decreased significantly ($p < 0.05$) compared to the rate before transplantation. In the allogeneic HSCT group, the rate of PSQI sleep disturbances on the 7th and 100th days after transplantation was significantly lower ($p < 0.05$) than that before transplantation (Table III).

Table III. Comparison of the total PSQI scores and the PSQI sleep disorder rates between the autologous and allogeneic HSCT groups before transplantation and on the 7th and 100th days after transplantation.

	Autologous		Allogeneic			
	Mean ± SD/n-%	Median	Mean ± SD/n-%	Median	*p*	
PSQI total						
Before transplantation (BT)	7.4 ± 5.6	6.0	10.7 ± 5.3	12.0	**0.047**	m
7th day	3.8 ± 4.2	1.0	5.3 ± 3.3	6.0	0.152	m
100th day	1.4 ± 2.1	0.0	2.6 ± 2.6	2.0	0.084	m
BT/7th day change	-3.5 ± 2.6	-4.0	-5.5 ± 3.0	-5.0	**0.023**	m
Intra-group change *p*	**< 0.001**	W	**< 0.001**	W		
BT/100th day change	-6.0 ± 4.4	-5.0	-8.1 ± 4.1	-8.0	0.100	m
Intra-group change *p*	**< 0.00**1	W	**< 0.001**	W		
PSQI sleep disorder						
Before transplantation					**0.017**	X2
No	9	47.4%	5	16.1%		
Yes	10	52.6%	26	83.9%		
7th day					**0.024**	X2
No	13	68.4%	11	35.5%		
Yes	6	31.6%	20	64.5%		
Intra-group change *p*	0.125	N	**0.031**	N		
100th day					0.802	X2
No	17	89.5%	27	87.1%		
Yes	2	10.5%	4	12.9%		
Intra-group change *p*	**0.008**	N	**< 0.001**	N		

[m]Mann-Whitney U test/[w]Wilcoxon test/[X2]Chi-Square test (Fisher test).

In terms of the PSQI subscales, no significant difference was found in the sleep quality scores between the autologous and allogeneic HSCT groups before transplantation and on the 7th and 100th days after transplantation ($p > 0.05$). However, in both autologous and allogeneic HSCT groups, sleep quality score on the 7th day after transplantation was significantly lower ($p < 0.05$) compared to the score before transplantation and on the 100th day after transplantation. In both groups, no significant difference ($p > 0.05$) was found in the decrease in sleep quality scores on the 7th and 100th days after transplantation. Considering sleep latency, the score before the transplantation was significantly higher ($p < 0.05$) in the allogeneic HSCT group than in the autologous HSCT group. In terms of the PSQI sleep duration sub-scale, the scores of the allogeneic HSCT group before transplantation were significantly higher ($p < 0.05$) than those of the autologous group, and no significant difference ($p > 0.05$) was found on the 7th-day and the 100th-day scores after transplantation between the groups. However, in both the autologous and allogeneic HSCT groups, the sleep activity efficiency scores on the 7th and 100th days after transplantation were significantly lower than before transplantation ($p < 0.05$). In the allogeneic group, the amount of decrease in the sleep efficiency score on the 7th day after transplantation was significantly higher ($p < 0.05$) than in the autologous group. The sleep disorder scores on the 7th day after transplantation did not show a significant difference between the autologous and allogeneic transplantation types. In the autologous and allogeneic HSCT groups, the sleep disorder scores on the 7th and 100th days after transplantation showed a significant decrease compared to those before transplantation ($p < 0.05$). In both the autologous and allogeneic HSCT groups, the drug use scores on the 7th and 100th days after transplantation were significantly lower than those before transplantation ($p < 0.05$). In the daytime activity subgroup, no significant difference ($p > 0.05$) was found in the daytime activity scores between the autologous and allogeneic transplantation types before transplantation and on the 7th and 100th days after transplantation. In both the autologous and allogeneic HSCT groups, the daytime activity scores on the 7th and 100th days after transplantation showed a significant decrease compared to those before transplantation ($p < 0.05$) (Table IV).

Table IV. Comparison of PSQI scale scores of the autologous and allogeneic HSCT groups on the 7th and 100th days after transplantation.

	Autologous		Allogeneic			
	Mean ± SD	Median	Mean ± SD	Median	*p*	
PSQI Sleep quality						
Before transplantation (BT)	1.42 ± 0.90	1.00	1.84 ± 0.93	2.00	0.114	m
7th day	0.74 ± 0.87	1.00	1.00 ± 0.82	1.00	0.218	m
100th day	0.21 ± 0.42	0.00	0.42 ± 0.62	0.00	0.245	m
BT/7th day change	-0.68 ± 0.67	-1.00	-0.84 ± 0.45	-1.00	0.253	m
Intra-group change *p*	**0.002**	w	**< 0.001**	w		
BT/100th day change	-1.21 ± 0.71	-1.00	-1.42 ± 0.81	-1.00	0.331	m
Intra-group change *p*	**< 0.001**	w	**< 0.001**	w		
Sleeping latency						
Before transplantation	1.16 ± 1.12	1.00	1.77 ± 0.88	2.00	**0.042**	m
7th day	0.63 ± 0.90	0.00	0.81 ± 0.83	1.00	0.356	m
100th day	0.21 ± 0.42	0.00	0.35 ± 0.61	0.00	0.472	m
BT/7th day change	-0.53 ± 0.77	0.00	-0.97 ± 0.91	-1.00	**0.034**	m
Intra-group change *p*	**0.007**	w	**< 0.001**	w		
BT/100th day change	-0.95 ± 0.97	-1.00	-1.42 ± 0.92	-1.00	0.093	m
Intra-group change *p*	**0.003**	w	**< 0.001**	w		
Sleep duration						
Before transplantation	1.21 ± 0.92	1.00	1.77 ± 0.92	2.00	**0.046**	m
7th day	0.68 ± 0.89	0.00	0.87 ± 0.76	1.00	0.345	m
100th day	0.26 ± 0.56	0.00	0.26 ± 0.51	0.00	0.934	m
BT/7th day change	-0.53 ± 0.61	0.00	-0.90 ± 0.79	-1.00	0.066	m
Intra-group change *p*	**0.004**	w	**< 0.001**	w		
BT/100th day change	-0.95 ± 0.85	-1.00	-1.52 ± 0.81	-2.00	**0.019**	m
Intra-group change *p*	**0.001**	w	**< 0.001**	w		
Sleep efficiency						
Before transplantation	1.21 ± 1.08	1.00	1.71 ± 0.94	2.00	0.090	m
7th day	0.79 ± 0.85	1.00	0.77 ± 0.72	1.00	0.949	m
100th day	0.26 ± 0.45	0.00	0.39 ± 0.56	0.00	0.468	m
BT/7th day change	-0.42 ± 0.51	0.00	-0.94 ± 0.57	-1.00	**0.00**3	m
Intra-group change *p*	**0.005**	w	**< 0.001**	w		
BT/100th day change	-0.95 ± 0.97	-1.00	-1.32 ± 0.83	-1.00	0.144	m
Intra-group change *p*	**0.003**	w	**< 0.001**	w		
Sleep disturbances						
Before transplantation	1.16 ± 0.90	1.00	1.58 ± 0.92	2.00	0.125	m
7th day	0.58 ± 0.69	0.00	1.00 ± 0.77	1.00	0.059	m
100th day	0.11 ± 0.32	0.00	0.58 ± 0.67	0.00	0.006	m
BT/7th day change	-0.58 ± 0.61	-1.00	-0.58 ± 0.62	-1.00	0.866	m
Intra-group change *p*	**0.002**	w	**< 0.001**	w		
BT/100th day change	-1.05 ± 0.85	-1.00	-1.00 ± 0.68	-1.00	0.973	m
Intra-group change *p*	**0.001**	w	**< 0.001**	w		

Continued

The ESS classification between the autologous and allogeneic HSCT groups did not differ significantly ($p > 0.05$). Similarly, a significant decrease ($p < 0.05$) was found when the 100th day after transplantation and pre-transplantation scores were examined in both groups (Table V).

Table IV *(Continued).* Comparison of PSQI scale scores of the autologous and allogeneic HSCT groups on the 7th and 100th days after transplantation.

	Autologous		Allogeneic			
	Mean ± SD	Median	Mean ± SD	Median	*p*	
Use of sleeping medication						
Before transplantation	0.79 ± 1.08	0.00	1.00 ± 0.89	1.00	0.302	m
7th day	0.32 ± 0.58	0.00	0.39 ± 0.67	0.00	0.780	m
100th day	0.21 ± 0.54	0.00	0.32 ± 0.60	0.00	0.430	m
BT/7th day change	-0.47 ± 0.70	0.00	-0.61 ± 0.72	0.00	0.458	m
Intra-group change *p*	**0.014**	w	**< 0.001**	w		
BT/100th day change	-0.58 ± 0.84	0.00	-0.68 ± 0.79	-1.00	0.479	m
Intra-group change *p*	**0.008**	w	**< 0.001**	w		
Daytime dysfunction						
Before transplantation	0.68 ± 0.89	0.00	1.03 ± 0.80	1.00	0.104	m
7th day	0.42 ± 0.69	0.00	0.29 ± 0.59	0.00	0.474	m
100th day	0.11 ± 0.32	0.00	0.16 ± 0.45	0.00	0.777	m
BT/7th day change	-0.26 ± 0.56	0.00	-0.74 ± 0.73	-1.00	0.028	m
Intra-group change *p*	0.059	w	**< 0.001**	w		
BT/100th day change	-0.58 ± 0.69	0.00	-0.87 ± 0.76	-1.00	0.181	m
Intra-group change *p*	**0.005**	w	**< 0.001**	w		

[m]Mann-Whitney U test/[w]Wilcoxon test.

In terms of the ISI scores, no significant difference ($p > 0.05$) was observed in both groups before transplantation and on the 7th and 100th days after transplantation. In the autologous HSCT group, the ISI scale classification on the 7th day after transplantation did not show a significant

Table V. Comparison of ESS scores between the autologous and allogeneic HSCT groups on the 7th and 100th days after transplantation.

		Autologous		Allogeneic			
		N	%	N	%	*p*	
Epworth sleepiness scale classification							
Before tansplantation	Normal	9	47.4%	10	32.3%	0.923	X2
	Mild	3	15.8%	10	32.3%		
	Moderate	1	5.3%	4	12.9%		
	Severe	3	15.8%	1	3.2%		
	Excessive	3	15.8%	6	19.4%		
7th day	Normal	8	42.1%	16	51.6%	0.532	X2
	Mild	7	36.8%	6	19.4%		
	Moderate	3	15.8%	4	12.9%		
	Excessive	1	5.3%	5	16.1%		
Intra-group change *p*		0.250	N	0.687	N		
100th day	Normal	17	89.5%	26	83.9%	0.279	X2
	Mild	2	10.5%	2	6.5%		
	Moderate	0	0.0%	3	9.7%		
Intra-group change *p*		**0.016**	N		**0.008**	N	

[N]MC Nemar test /[X2]Chi-Square test (Fisher test).

change ($p > 0.05$) compared to scores before transplantation, while the scores on the 100th day decreased significantly ($p < 0.05$) compared to the scores before transplantation. In the allogeneic HSCT group, a significant decrease ($p < 0.05$) was found in the ISI scale classification on the 7th and 100th days after transplantation compared to that before transplantation (Table VI).

Discussion

Sleep is an important restorative and biological process for health. Sleep disorders adversely affect psychological and physical health and disrupt the circadian rhythm, leading to psychiatric problems and deterioration in quality of life[14]. Sleep disorders are quite common in patients with cancer or HSCT. Intensive chemotherapeutic procedures and their side effects, as well as medical and psychosocial risk factors related to the disease, are associated with the prevalence and severity of sleep disorders. Sleep disorders, especially in severe cancer patients, impair quality of life and slow down the recovery process[15-16]. Therefore, it is of great importance to investigate and treat sleep disorders in this patient group. The outstanding result of our study is that sleep disorders showed a statistically significant decrease after transplantation compared to before transplantation. In a 2009 study by Rischer et al[10], who investigated sleep disorders in autologous and allogeneic HSCT patients the mean age of 50 patients was 53.3 year and allogeneic HSCT was performed in 78% of the patients, and autologous HSCT was performed in 22% of the patients. In our study, the mean age was 42.5 years and 62% of the patients underwent allogeneic HSCT, 38% underwent autologous HSCT, and allogeneic HSCTs were the majority[10]. In the HNKN study conducted by Iskender et al[17], 70% of the patients were male and 30% female. In our study 66% of the participants were male, and 34% were female.

Rentscher et al[11] investigated sleep disorders in allogeneic HSCT patients and found that 48.1% of the patients had a basal PSQI score above 5 and were diagnosed with sleep disorders before HSCT. On the 100th day after HSCT, the rate of patients with a PSQI score above 5 decreased to 43.2%. In another study[10] conducted in 2009, the rate of sleep disturbances according to the PSQI score in patients who underwent HSCT was 32% before HSCT, 77.3% before discharge, and 28.1% on the 100th day after the procedure. The PSQI sleep disorder score before and after transplantation was significantly higher ($p < 0.05$) in the allogeneic HSCT group than in the autologous HSCT group on the 7th day. In our study, according to the PSQI scores before HSCT, 72% of the patients had sleep disorders, and this rate decreased to 52% on the 7th day and 12% on the 100th day after HSCT. Similar to the literature,

Table VI. Comparison of ISI scale scores between the autologous and allogeneic HSCT groups on the 7th and 100th days after transplantation.

		Autologous		Allogeneic			
		N	%	N	%	p	
Insomnia severity index classification							
Before transplantation	Indifferent	3	15.8%	6	19.4%	0.750	X2
	Subthreshold insomnia	9	47.4%	17	54.8%		
	Moderate insomnia	6	31.6%	7	22.6%		
	Severe insomnia	1	5.3%	1	3.2%		
7th day	Indifferent	5	26.3%	13	41.9%	0.264	X2
	Subthreshold insomnia	12	63.2%	14	45.2%		
	Moderate insomnia	2	10.5%	4	12.9%		
Intra-group change *p*		0.500	N	**0.016**	N		
100th day	Indifferent	14	73.7%	23	74.2%	0.968	X2
	Subthreshold insomnia	5	26.3%	7	22.6%		
	Moderate insomnia	0	0.0%	1	3.2%		
Intra-group change *p*		**0.001**	N		< **0.001**	N	

NMC Nemar test/X2Chi-Square test (Fisher test).

sleep disorders were significantly reduced in the patients after HSCT. Moreover, in our study, the scores in the seven subscales of the PSQI showed a statistically significant decrease on the 7th and 100th days after transplantation, and sleep statistically improved and showed great improvement on the 100th day after transplantation.

In terms of the ESS, the daytime sleepiness of the patients decreased significantly on the 7th and 100th days after transplantation compared to the period before transplantation. In a study[18] conducted in 2003 that evaluated the quality of life of patients with multiple myeloma before transplantation, 43.3% of patients had daytime sleepiness. In our study, the rate of patients with ESS scores above normal was 62% before the transplantation, 52% on the 7th day and 14% on the 100th day after transplantation.

In terms of the ISI, the rate of patients with insomnia symptoms from mild to severe decreased from 82% before transplantation to 64% on the 7th day and 26% on the 100th day after transplantation. The insomnia complaints of the patients showed a statistically significant decrease due to HSCT. It has been previously shown that the insomnia rates in HSCT patients was 55% before transplantation, 70% on the 30th day after transplantation and again 55% on the 100th day after transplantation. In another study[19] investigating insomnia rates in patients hospitalised for HSCT, 74% of the patients had insomnia complaints, similar to our study.

In examining the sleep disorders between the autologous and allogeneic HSCT groups, the sleep latency and sleep duration scores of the PSQI subscales were significantly higher in the allogeneic group. No significant difference was found between the two groups in sleep quality, sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction scores in the PSQI subscales. Similarly, no significant difference was observed between the allogeneic and autologous HSCT groups on the ESS and ISI scales. In a study[20] conducted in 2018 evaluating sleep disorders in HSCT patients, the allogeneic transplantation type was evaluated as a risk factor for sleep disorders. In a study[9] conducted in 2009 investigating sleep disorders and emotional stress in HSCT patients, sleep quality was found to be worse in the allogeneic group than in the autologous group, similar to our study. We believe that the reason why sleep quality is worse in the allogeneic transplantation group can be explained by the following parameters: the preparation procedures that last about one week before transplantation, the chemotherapy treatment given in the three days immediately after the transplantation, the combined drug treatments in the preparation procedure, the severity of the process compared to that in the autologous group, prolonged hospital stays and the side effect profile of the treatment.

Limitations

The limitations of our study are as follows: psychiatric conditions, such as anxiety and depression, which most commonly accompany sleep disorders, were not analysed; the scale for anxiety and depression was not applied to the patients; the number of patients was low. Extensive studies are needed with more patients.

Conclusions

Sleep disorders before and after transplantation are common and significant problems that affect the quality of life of HSCT patients. We believe that early detection and treatment of sleep disorders may be beneficial for this group of patients to improve their quality of life and response to treatment. The awareness of clinicians who encounter this group of patients should be increased in this regard. We believe that our study can set an example for other studies to be conducted in this field and can be beneficial in raising awareness among clinicians.

Conflict of Interest

The Authors declare that they have no conflict of interests.

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None.

Data Availability

The datasets generated and/or analyzed during the current study are not publicly available due to privacy concerns but are available from the corresponding author on reasonable request.

Authors' Contribution

F. Yavlal: Conceptualization, Data curation, Methodology, Project administration, Resources, Supervision, Writing - original draft, Writing - review & editing. Y.G. Aras: Formal analysis, Methodology, Supervision, Visualization, Writing - original draft. S.B. Ulaş: Resources Investigation, Visualization, Writing - original draft. Each author gave

the final approval of the version to be published and agreed to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Ethical Approval

The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was conducted prospectively between February 2022 and July 2022. Approval of the Biruni University Non-Pharmaceutical Clinical Research Ethics Committee was received on 16.02.2022 with the number 2015-KAEK-60-22-08.

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Informed Consent

Informed Consent was obtained from all individual participants included in the study.

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